THE

Indian Tea Association.

SCIENTIFIC DEPARTMENT

QUARTERLY JOURNAL.

PART I.

1914.

Calcutta:
PRINTED AT THE CATHOLIC ORPHAN PRESS,
3 & 4, PORTUGUESE CHURCH STREET.

1914.

CONTENTS.

CONTROL OF IMPORTED TEA SEED*

BY

DR. CH. BERNARD & DR. J. J. B. DEUSS.

Being a re-print with Dr. Bernard's permission of a pamphlet published in English by the Department of Agriculture, Industry and Commerce in Buitenzorg, Java.

In recent years there have been numerous complaints in Java about the quality of the tea seed imported from British India. Although formerly seed arrived in good condition and gave good germination results, the quality has gradually deteriorated as the bulk of the imports increased. In the planting seasons 1910/11 and 1911/12 the seed was particularly bad and there are not a few planters who received big quantities of seed with more than 50% in wretched condition; cases have been cited where lots of 100 to 200 maunds gave even less than 20% germination.

The point has been discussed over and over again by the Sockaboemi Planters Association, especially at the meeting of 13th March 1912, and after the attention of the Director of Agriculture had been called to it, it was decided to hold an enquiry in the countries of origin. As the results of this enquiry and the whole question generally have already been dealt with in Memoranda No. XX from the Tea Experimental Station there is no need to dwell upon them here. The two main conclusions of the enquiry were, firstly that the sellers and exporters in Calcutta (or at any rate the greater part of them) would not be prepared to change the current form of sale contract and would refuse to give a guarantee in Java or reduce the sale price in case of proved bad quality, and secondly that it is in Java that the necessary steps must be taken.

(*).—*De controle der ingevoerde theezaden.—Mededeelingen van het Theeproefstation, 'No. XXII.—Mr. Wykeham Price, Chief of the Bombay Java Trading Co., has been so 'kind as to translate this publication into English, for which kindness we herewith beg to 'tender our grateful thanks."*

A provisional sketch of the possible steps was published in the above-mentioned Memoranda, shewing that it was specially desirable to institute a form of control which would give figures capable of furnishing useful information as to the relative value of various jats, packing, etc. These figures or rather the general conclusions drawn from them should be published and the effect in any case would be that the exporters in Calcutta knowing that such steps were being taken would take more care over harvesting and despatching the seed for the sake of their good names. The establishment of such a control would furnish planters with more or less of a guarantee (since in their buying contract they could stipulate for delivery of the Priok control certificate) and similarly also for importers who could take up a stronger attitude towards their Calcutta correspondents and towards the sometimes badly founded complaints from their Java clients.

Seeing that to get satisfactory results all seed must be inspected it was suggested that Government should publish an Ordinance, making seed control at Priok compulsory and prohibiting the import of all seed not provided with a Certificate signed on behalf of the Director of Agriculture by his nominee say the Head of the Tea Experimental Station or his staff, the main point of such inspection being the risk of importation of infection into Java (†).

This regulation will come into force on 1st October 1913, but while waiting for the official control we have in consultation with the Director of Agriculture tried to effect something on a small scale so as to see what can best be done in the future and in this manner we have been able to fix upon certain points of general interest:

We have got into touch with most of the importers in Batavia who all very willingly agreed to submit their seed to control and promised to supply us with such samples from their shipments as we require for our examination. We have also arranged with the various Stevedore Companies at Priok that we should be promptly warned of the arrival of seed so that we may at once be present. In the last two months we have been 10 times to Priok and devoted

(†).—Hereafter a translation of the text of the Ordinance has been published.

our attention to 100 shipments consisting of more than 30 different jats, i.e. Alyne, Arcuttipore, Bazalony, Bhootachung, (Bhutiachang ?) Burma, Dangri, Dhonjan, (Dinjan ?) Dutea, Gairhata, (Gairkhatta ?) Gillapuk, Hansara, Hapjan, Hatticherra, Hilara, Huldibari, Itakhoolie, Jaipur, Jattinga, (Jetinga ?) Kalline, Kutchu (Kutchujan ?) Manipur, Mithunguri, Nakhati, Namsang, Rajchur, (Rajghur ?) Rowes, Rungli-Ting, Singlo-Hill, Stunzi, Tengabari and others the names of which were not supplied to us.

Out of each shipment we opened a certain number of boxes, the number varying according as the boxes appeared to us to be badly packed or in any way remarkable. Our idea was to open at least 1 case in 20 or 1 in 10 according to the state of the contents; we were not able to carry it out in all cases, but our experiments have shewn us that to get a proper idea of a shipment as a whole it is desirable to open a greater number and we propose to do so in future.

From each opened box we took 100 seed or rather more and put them in bags, carefully labelled to prevent any mixing up, and there and then made our notes as to the condition of the boxes, the packing, temperature of the contents and the external appearance of the seed, etc. On our return to Buitenzorg we tested the seed. It has been pointed out to us that it would be better to finish off the whole process of control at Priok on account of the possible affect of some days delay on the quality of the seed and this is undoubtedly true but insuperable difficulties make it impossible to carry out the work in the medley of the wharf godowns in addition to which as the process properly done takes 3 days it can only be done at Buitenzorg. We have also noticed that keeping the seed in bags for a day to allow of transport from Priok to Buitenzorg does not make much difference in their value.

The testing is done as follows:—The seed are thrown into water, each sack separately and if no particular irregularities are noticed in the percentage of sinkers or in the external appearance of the seed, the samples of one invoice are lumped together. At first we counted the sinkers immediately, after $\frac{1}{2}$ an hour, an hour and 2 hours but we have since learnt that it is enough to count

them immediately and after 2 hours, and we shall pursue this simpler method in future.

On some Java estates the floaters and sinkers are separated after being in the water for 12 hours or more, but we consider this too long because seed which sink after 10 or 12 hours generally contain a very heavy percentage of rotten or mouldy pips, and although submersion for 2 hours is perhaps a little short it seems to us sufficient for drawing conclusions from.

By this means we obtain first of all a classification according to specific gravity, which however is not conclusive though in the majority of cases sinkers are of better quality than floaters, but experience has shown that often a big percentage of floaters are good and that very bad seed can sink; thus for example we once found in a case containing 100% rotten or mouldy seed about 30% that sank after 2 hours in water.

For the above reasons we have reserved say $\frac{2}{3}$ of the sinkers and $\frac{1}{3}$ of the floaters for sowing, while the balance were opened and carefully examined. This enabled us to establish a second check and to divide the seed again into:

good i.e. with healthy germ and the seed kernels hard and completely filling the shell;

good(?) i.e. doubtful, with the germ sometimes a bit yellow and the kernels dry, a little soft, or perhaps yellowish;

bad i.e. 1. a little mouldy or rotten;

2. very much dried up;

3. utterly rotten, mouldy or empty.

It is possible that our scheme of control is a bit severe and we realize that seed is often considered good that we should class as doubtful, but still we have thought it desirable to make the distinction because even if the doubtful seeds do germinate they mostly produce backward plants which do not shew normal development. At the same time it would be quite wrong to throw away these doubtful seed as a priori useless.

The seed described as somewhat mouldy or rotten and those dried up must be classed as bad, even if the harmful organisms are

only slightly developed because during the time that these seeds take to germinate the fungi and bacteria will have also developed in excess in the interior of the shell whether placed in earth or damp sand and have caused a far advanced or total destruction of the contents of the seed. Certainly, some part of this bad seed will germinate but only a small quantity of plants will be obtained, in addition to which the kernels will always have been more or less affected and the plants will accordingly have some abnormal development.

Later on we shall be able to have a third check, as soon as we know the number of germinated seed and the appearance of the plants, and eventually a fourth form of check, because we hope to keep in touch with the planters who receive the seed, and shall ask them to keep us advised of the results obtained.

All our figures and comments are entered up before and after on a special form and each year after arrival of the seed we can extract from our data some useful figures.

Herewith we give an example of the way the work is done; it concerns a small shipment destined for nurseries laid out at Tjinjiroean for selection purposes. The italics shew the data recorded by us in the course of our examination.

TEA EXPERIMENTAL STATION—SEED CONTROL.—1912-1913.

Jat *Lushai Hill (Manipuri)* .... Number of boxes 2
Exported by ....Guarantee *77% at Calcutta*
Imported by *Tea Experimental Station.* ....
Destined for *Tjinjiroean.* ....
Packed *in dry charcoal.* ....
Despatched from Calcutta *7 XI 12.*—Arrived at Priok *23 XI 12.*
Despatched from Priok *2 XII.*—Arrived at *Tjinjiroean* ....
Planted (as seed) (in nurseries) ....
Brokers certificate in Calcutta "*More than 70% good seed.*" ....

Certificate of the Tea Experimental Station...

Soundness of the seed. *No bad organisms observed.*...............................

Disinfection of the ship (if any) ....

Disinfection of the seed (if any). *The seeds were disinfected at Tjinjiroean in a solution of sublimate of 1 per 1000.* ....

Remarks. *Owing to a misunderstanding the examination was made too late. The packing was not good; the wood was strong but the boxes were badly closed without either hoopiron or sacking; the boxes were too big and not completely filled; the seeds were not mouldy or germinated. One box had a higher percentage of floaters and doubtful seeds.*

Date of the examination *3 XII.* Sample drawn from *2* of the *2* boxes. *40·9%* sinkers. *88* (at once *71*, after ½ hour *5*, after 1 hour *3*, after 2 hours *9*) *59·1%* floaters, *127*.

(of the sinkers.................. seeds had germinated).

Sown:	Germinated:				
	after *6* days.	after *18* days.	after *45* days.	after *60* days.	Total.
40 sinkers.....	*14*	*23*	*3*	*0*	*40*
58 floaters.....	*5*	*29*	*3*	*1*	*38*

Opened	Good seed, healthy kernels.	Good (?), rather soft kernels.	Bad seed.		Entirely rotten or empty.
			Mouldy rotten.	dried up.	
43 sinkers	*38*	*4*	—	—	*1*
58 floaters	*12*	*25*	*3*	*5*	*13*

49·5% good
28·7% good ?
21·8% bad

Average dimensions of seeds: *Regular, few very small and very large seeds.*

Remarks.—Health of the plants.—Etc.—..

....

....

This method of classification is particularly simple and quick, even when large quantities of seed arrive together and a number of samples must be examined on the same day.

It would certainly be better if we could go into more details and extend our examination over more seed, but it seems to us

desirable to restrict ourselves to certain limits, in addition to which it must not be forgotten that we do not wish our examination to cause in any way delay in the forwarding of the seed and the first care must be that seed is not kept at Priok longer than necessary, while further we are not entitled to draw an excessive number of samples from the boxes on account of the loss to the consignee. Although our researches to date have been made with a limited number of seed they will none the less be of value to compare with the planters' examination after receipt of the seed and since the latter concern the whole shipment and not samples picked here and there they will enable us to see if the results of our investigations agree with the actual facts.

The 99 examinations we have made have given the following results :

Below			50%	sinkers	10
From	50	to	60%	"	8
"	60	"	70%	"	20
"	70	"	80%	"	20
"	80	"	90%	"	23
"	90	"	100%	"	18
					99

These figures form a possible basis for determining the percentage of good seed but as already mentioned a certain number of sinkers are always bad while a certain number of floaters can in proportion to the goodness or otherwise of the packing give good results. We therefore think it desirable to use our second check method as a basis. It would then be possible either to take only the seeds classed by us as absolutely good, which would be abnormally strict, or one might add to the good seed a part, say half, of the doubtful, or lastly mix up the good and doubtful together. It is this last method that we have adhered to, because it seems to us nearest to actual conditions. As a rule the figure thus obtained is a trifle lower than that of sinkers alone but the first in an almost constant ratio to the second and appears to be more in agreement with the percentage of germination. Seeing that in addition we carry out our control pretty strictly as regards doubtful and especi-

ally as regards slightly mouldy seeds, which we class as bad if there is the slightest trace of mildew on the kernels, it can be taken for granted that if part of the doubtful seeds give poor results part of the slightly mouldy ones are likely to give good plants (especially if they germinate quickly), and these plants will not be in any way injuriously affected by a little mildew and will compensate for the loss of those doubtful ones which have not struck.

The following figures have been obtained by adding together the good and doubtful seeds in our 99 experiments:

Below	50%	good + good (?)	seed	8
From	50— 60%	"	"	13
"	60— 70%	"	"	26
"	70— 80%	"	"	35
"	80— 90%	"	"	13
"	90—100%	"	"	4
				99

It would undoubtedly be best to take as basis our third check method (percentage of seed that have struck after a given time) but we require data at once and cannot wait for several months before coming to a decision, so that the third check must wait to be of use later on for comparison.

The percentage of sinkers and of good seed shew that this year planters will have little right to complain since the number of tests gave only one lot with 50% bad, and this is specially the case when one realizes that the bulk of these bad lots had to contend with abnormal circumstances which might have been avoided and hinder them from being compared with the good lots. The majority of the lots tested gave 70—100% sinkers or good seed which in Java must be considered as *very* satisfactory indeed and marking an appreciable improvement on the seed of previous years. This improvement has been noticed by both planters and importers, and many of the latter have advised us that they have noticed that the quality of this year's seed was decidedly better than that of the last 2 years, and that they are convinced that this is due to the fact that many of them had warned their Calcutta correspondents that in all probability there would be a seed test at Priok, and that the quality

would be officially controlled. One importer told us in addition, that one jat which last year gave only 30% sinkers, gave in 1912/3 80—100% in each box and that this could not have been due to climatic differences, but only to increased care in harvesting and packing, stronger boxes and better filling.

This point, *packing*, is in fact of the greatest importance and we consider that one result of our preliminary investigation is the proof that this point has the greatest possible influence on the quality of the seed as it arrives in Java. The causes of the bad seed in the past years have been sought far and wide, and suggestions have been made of seed harvested unripe, of disinfection of ships, of unhealthy mother trees and so forth, all of which contributory factors must not be lost sight of but their effect is infinitely less than that of faulty packing. It can be easily understood, that in view of the big demand for seed in the last year or two, there was a rush on the Estates in Assam to get off the big quantities ordered, with the result that less care was paid to packing, and a larger part of the seed arrived damaged.

In our opinion it is very necessary that Java planters and importers should draw the special attention of their Calcutta friends to this point, and demand a packing exactly in accordance with their specification.

We do not wish to give as final our observations from this year only, as possibly they may be changed after further research, but we think we can already lay down certain points and will deal with them at some length owing to their importance.

To illustrate the influence of packing in general, we would repeat the following very telling case; during one of our tests we met with one big invoice of which we intended to open only a few boxes, but at first sight we noticed that the boxes were irregular in size, incompletely filled and in some cases containing poor seed. In the big boxes the seed was fresh and on the whole in good condition, but in the small ones, in which the quantity of earth was less in proportion, the temperature was higher, the number of mouldy seed greater and in one case we even found every seed rotten; the whole inside of the box, where it was very hot, was

covered with green mildew. We only saw one case in this condition but it is very possible that there were a large number and in any case this seed came from the same garden and formed one lot so that it cannot be allowed that there was any difference in ripeness or in liability to insect attacks or other disease and seeing that presumably all these seeds were alike at the start the one logical reason for the big difference is that the packing was faulty, the packing earth perhaps too damp, or the quantity of seed too great for the small boxes, which would foster the mildew.

There is much difference in the packing of tea seed, both as regards the making of the boxes and the material in which the seed is packed, while each shipper uses different proportions of this packing material.

The *wood* of which the chests are made is sometimes very strong, but often soft wood (inter alia *Albizzia*) is used, possibly already riddled by insects, while sometimes the boards are too thin and thus crushed in by the time they get here. It must not be forgotten that at both loading and discharging, as we have frequently noticed at Priok, there is the minimum of care or attention paid to the weak boxes and we have seen whole piles of boxes thrown down by coolies so that they fell upon each other and smashed.

One of the first requirements is that the wood should be of good quality and the boards thick. The two or three boards forming the top or bottom of the boxes should be nailed or fastened together, which we have noticed is nearly always the case, but if possible it should be seen that the boards forming the sides should be dovetailed (Fig. 1) because cases piled one on another are often not crushed, but burst open at the corners or sides, which must therefore be as supple as the tops and bottoms.

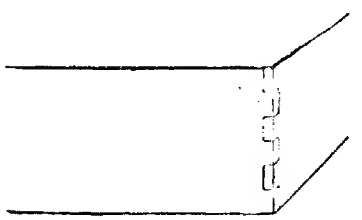

Fig 1

Sometimes the wood of "Venesta Chests" is used, which is very unadvisable. We have seen one invoice of these chests of which the

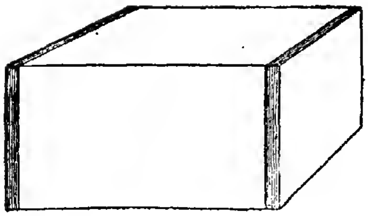

Fig. 2.

greater part were broken, while in another invoice Venesta boards had been used or tops and bottoms and these were all crushed in.

Possibly the precautions we recommend may slightly increased the cost, but this must not be considered, when we have to do with packages containing material worth hundreds of guilders.

In any case it is possible to avoid the chests becoming entirely empty owing to breakage if it is demanded that they should be overed with strong *sacking*. We have seen chests almost entirely mashed which had lost none of their contents, owing to the heavy nd closely sewn gunny, with which they were covered. Others rithout this precaution were quite empty.

Other steps for strengthening the boxes must also be required; s a rule they have two *iron hoops* at the extreme ends (Fig. 2) vhich is insufficient if the wood is not strong, and a third hoop cross the middle helps very much towards strengthening the box Fig. 3). We have also seen shipments, which in addition to these hree iron hoops had 2 hoopirons in cross form (Fig. 4) and this is much the best plan, and should be always asked for, as it almost ensures a sufficiently strong box even if the wood is inferior.

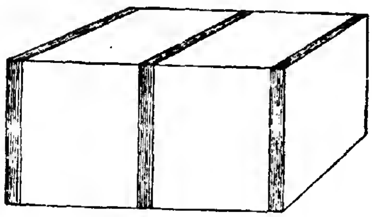

Fig 3

In some cases, boxes provided with hoopiron at the ends, had the long sides strengthened with *tin clamps* 'ig 5), while one or two very well packed lots had, in addition to cking and hooping on the ends, two or three hoopirons over the cking.

In almost every case, (and this should always be strictly emanded) the ends of the boxes are strengthened from within by

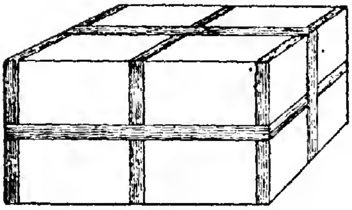

Fig 4

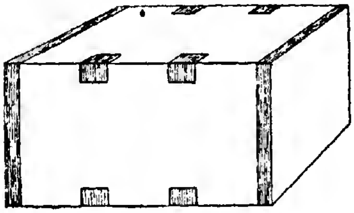

Fig 5.

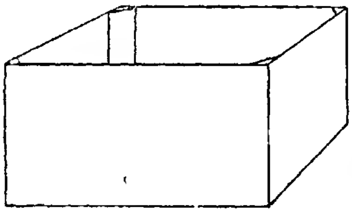

Fig. 6

means of triangular *bits of wood*, which prevent the squashing of the chests or the breaking of the sides (Fig. 6).

The *measurements* of the boxes are not unimportant; if they are too small for ½ a maund they have to be filled too tight with too little packing material, and if the latter is hygroscopic, part of the seed swells and germinates and bursts the box; if there are too many seeds, many go rotten and fermentation is set up, which causes great heating. We have noticed this a number of times, because in many cases the boxes were too small, and the heat was often so great that it was almost impossible to hold one's hand in them.

Too big boxes are also bad, because, if not completely filled the earth or charcoal sinks to the bottom owing to the excessive movement of the seed, which become mouldy, while the top of the box is empty and easily crushed in.

Boxes of irregular sizes, which we have sometimes noticed, are also wrong, as they are difficult to pile, with the result that they are more liable to get crushed in. In the case mentioned above we noticed that in the one invoice containing big and little boxes there was a very marked difference in the quality of the seed and entirely in favour of the big boxes.

It is thus possible to insist upon the following: boxes of even size, and sufficiently big to allow of a suitable quantity of packing material.

The *packing material* and the manner of using it are of course of the utmost importance. Before everything it is necessary that at the moment of despatch the seeds are not too damp, because if so it is impossible to regulate the humidity in the interior of the case, which has so much effect ; we have seen boxes with too damp contents in which many seeds had germinated, or worse still, had become mouldy, and even the paper used as lining had become nearly disintegrated.

Three different materials are as a rule used for packing i.e. charcoal or clay in a dry powder or fine sand, while sometimes all three are mixed in various proportions.

Charcoal is theoretically the best of the three, as it is easily obtainable in large quantities, can be powdered and dried to taste and prevents mouldiness. As a rule the lots tested by us which were packed in charcoal contained a much smaller percentage of mouldy seed. But charcoal has one big defect : if it is used quite dry it dries up the seed owing to its own hygroscopic character, and in nearly all the lots packed in dry charcoal we found a large percentage of dried up seed, which had to be classed as bad. If charcoal is artificially damped, there is the risk of going too far and obtaining a lot of germinated seed, whose roots as we noticed, were often some centimeters long, and as the charcoal gradually loses its humidity during the voyage these roots dry up and the seeds become valueless. It is quite certain that if the necessary degree of dampness is accurately obtained the seed arrives in good condition, and we have come across several lots like this, containing more than 90% sinkers and 80% good seed. But this accurate degree of dampness seems very difficult to obtain, and generally the charcoal results are unsatisfactory owing to the large quantity of doubtful seed (of which many come up) and the dried up or germinated seed.

The above trouble seems easier to avoid with *yellow or grey clay* which is often used. Without doubt it is difficult to dry it as much as charcoal as it always retains some moisture which keeps the seed in good condition, and although it is true as we have often noticed, there is a danger of increasing the number of mouldy or rotten seed together with the greater danger from too damp clay, than from too

dry charcoal, yet it is apparently easier to catch the happy mean with dry earth, which must be dry enough to keep powdery, but this powder must always be capable of being pressed into a lump with the fingers.

We cannot yet say it for certain, and we hope to pay much attention to the point in the future, but we think we may now assert that it is easier for the reasons given, to obtain a good packing material from clay, although theoretically charcoal is best. Only figures however based on a large number of shipments can settle this point definitely.

A well prepared mixture of *charcoal and clay* would perhaps have the advantages of both without the defects, and we have seen several lots thus packed, where the condition of the seed was excellent, even though the quantity of charcoal was generally speaking too small. Without doubt this packing will be adhered to after the mixture has been more carefully studied.

A few comparative figures will illustrate the effect of clay and charcoal under different circumstances: thus in 2 invoices packed in sufficiently damp charcoal we found 93 and 98% sinkers and 72 and 73% satisfactory seed (i.e. the total of good and doubtful seed added together), while in too damp charcoal we found in one invoice 30% and in another 40% of germinated seed, of which many had roots of several centimeters. We also tested a shipment of which some of the boxes were packed with very dry charcoal, and others in almost dry clay; the results were:

In clay:	78% sinkers. –	71% good,	6·5% good (?),	22·5% bad.
In charcoal:	50% ,,	53% ,,	1·8% ,,	29% ,,

The increase will be noticed in the number of doubtful seeds i.e. those with dried kernels.

In a mixture of clay and charcoal, with the latter in sufficient quantity, we found 76—85% sinkers and 70—90% satisfactory seed.

We have tested a few lots packed in fine dry *sand* of various kinds, but we cannot give a definite opinion on this system, though it strikes us as bad in several respects; it has not the good points of powdered clay nor of charcoal, but we shall investigate the point further.

The way in which the seeds are laid in the box is also not without interest. Mostly the mixture of seeds and clay or charcoal is merely thrown into the box, so that, especially if the cases are too big, the dry powder falls to the bottom, and leaves the seed at the top unpacked and exposed to drying. As a general rule it should be done by laying the seed in the packing material in layers separated by paper, and the seed we have seen packed like this was very fine.

Another method which we have seen was exceptionally good, where the seed was placed in layers of powdery dry clay separated by layers of damper clay, the whole being pressed into a mass. In the completely filled cases the seed had an excellent appearance with 96·7 % sinkers and 84·3 % satisfactory seed.

We will now by the way mention some details which form a subject for later study.

We have tried to draw conclusions as to the value of seed from their *size*, but we have not succeeded in finding a general rule and would stick to the comment mentioned in a former article (Memoranda No. VII page 3) i.e. that very small seed (of less than 12 millimetres in diameter) generally gives bad results with weak plants, and that the very big seed (19 to 21 millimetres) are also not good as they are often more or less dried up or rotten. Regular seed of good average thickness should have the preference as a rule.

As a maund is a measure of weight (36 Kilos) it is an advantage to get small seed as the number to a maund is greater. As a rule there are 20,000 per maund but it is not uncommon to find 26,000 ; but the disadvantages of small seed cause them to be out of favour.

It has been maintained that the bad condition of the seed in previous years was attributable to accidental causes, as a bad *attack of insects* (*Poecilocoris*) which had bored through the hard shell and set up mildew. We have already published (Memoranda No. XIX page 8) the comments on this in British India where it is maintained that the holes bored by these insects give the solution to the riddle, as to how the kernels could be mouldy despite the protection of the shell. The presence of these insects in a seed garden can undoubtedly exert an influence, but we have convinced ourselves that the boring of an insect or a hole or two in the hard shell are

not by any means necessary for mildew in the inside. It is very probable that the fungus strings can, without difficulty, pierce into the centre through the point of small resistance in the shell which we have often commented on, and described as the "eye", i.e. the point where the seed was attached to the fruit. The above mentioned case where the contents of a box was entirely rotten, has given us some information on this point; the seeds were affected both inside and out, so that the mycelium strings must have found a way in through a weak point of the shell, since there is no reason to believe that this particular box contained a greater proportion of seed which had been bored.

That the *Poecilocoris* plays a part in the quality of the seed appears to us quite intelligible, and we have handled many of these insects caught in large numbers in a Java seed garden, when a falling off in crop was attributed to them. Our opinion however is that the function of these insects is to consume the sap of the flowers and very young soft seeds and we do not think that their long sucker could penetrate the shell of ripe seed.

Blame has also been laid at the door of the Claytonising of the ships, but we have already said that this probably is wrong. Sulphuric dioxyde gas could by long application decrease or even destroy the germinating power of seed, but could not set up mildew; on the contrary, it appears to check it. In any case for security's sake and to reduce all chance of damage to the seed, steps, were taken last season which must be of use; if a ship containing tea seed must be claytonized, the seed is taken out of the hold before the disinfection is begun, so that the seed is not in contact with the sulphur. As, however, this question of the effect of Claytonization is of importance and not yet solved, we have asked, that, as an experiment, one or two cases may be left in the hold, and that samples may be sent to us for examination, but the opportunity for this has not yet occurred.

Lastly there is a very important point that must be impressed upon the exporters in Calcutta, and that is, that as certain details prove, *seed is often plucked* instead of being harvested under the trees fully ripe.

We would recommend planters and importers to start concerted action to see that seed is landed and transported as quickly as possible, and planted out immediately on arrival. Frequently the consignees for one reason or another are not advised in time, of despatch of seed to them, or take steps to receive it too late. It may be thought that such a recommendation is superfluous but we ourselves have several times seen considerable lots discharged, and lying in the wharf sheds without any orders from the consignee as to receipt and despatch, and we even saw one fair sized invoice which stood for a week in a corner of the shed before any one knew for whom it was intended. There is no doubt that the seed in this invoice must have suffered from lying so long in an exceptionally warm place, and must have caused well founded complaints.

All measures for receipt of the seed should be taken some time before, so that the Stevedore Companies know exactly what they have to receive, and to whom it must be despatched, and an attempt should also be made to prevent all these very similar boxes from being landed in a mass, so that there is the greatest difficulty in finding the various lots. In this respect it would be easy to do something such as for instance providing all chests on shipment with a particular mark, say a stripe of paint, so that they could all be identified at first sight and without loss of time. In addition it would help the control if each box bore the name of the jat.

Many planters employ the following method of testing after separating sinkers and floaters they take from each lot the seed which are too black or too light colonred ; i.e. all which are not of the pretty dark brown of healthy seed ; these they treat separately as inferior, and this distinction, though not infallible, gives valuable information and has also the advantage that there is no loss of seed as when seed is opened. We have also noticed that with seed packed in clay there is often earth stuck to many of the seed, and it can, almost without exception be said, that such seed is rotten or mouldy. It goes without saying, that these two indications (colour or lumps of clay sticking to the seed) do not occur with seed packed in charcoal.

STEPS TO BE TAKEN IN JAVA.

As shewn in the circular recently sent to members of the Tea Experimental Station it is not our intention to publish the certificate of our seed tests, seeing that it is obvious, that we cannot appear in any business which has a commercial side to it, and we shall merely continue as now to publish the general conclusions in our Memoranda. Importers will receive copies of our test certificates, and if they publish them, that is their affair, while if planters send us separate samples we shall also advise them of the result of our tests, which may be different from those made at Priok. It is not for us to take the immediately useful steps, but for the importers and planters, acting on the impartial data which we supply to them. We think it is quite possible to come to an agreement which should appreciably raise the quality of the seed, or at least reduce the risk of bad quality. At present it is the buyer only who shoulders the responsibility, and in the case of the absolute failure of a whole shipment, great or small, cheap or dear, he has no claim against anybody. This is decidedly unjust but it would be even less just if the importers who work only as intermediaries had to carry the whole risk.

It would undoubtedly be best to obtain from sellers in Calcutta a change in the delivery terms with compensation according to the quality on arrival at Priok. This compensation would have to be fixed upon a settled scale, similar to that used in British India, and attached to each sale note, but the scale would have to be based on another minimum percentage, and in our opinion exporters could not grumble at a guarantee of 50% good seed at Priok.

Unfortunately, however, it can be taken for granted that many exporters will not accept these terms, but it would be worth while trying, for some exporters already give a guarantee at Priok, and we see no reason why it should not be obtainable from all. In any case we should be able to obtain a reduction in price when badness of quality is caused by defective packing and officially certified.

But in the meantime, or if this proposal is rejected we can do something here, and we hope to call a meeting of planters, representatives, and importers, to decide on what basis we can proceed.

The first step for planters to take, is to make a condition of all future purchases that our Priok test certificate is supplied to them as also the certificate given in Calcutta. They would then, at any rate, know the condition of their seed on its arrival at Priok.

Importers would also cover to some extent their responsibility, for we have noticed that planters sometimes complain unjustly, considering an invoice of inferior quality if it contains roughly 70% of sinkers or good seed. In our opinion 70% in Java must be considered as very satisfactory, and we cannot ask for more, when we realize, that in Calcutta itself 70% is taken as the minimum but does not entitle one to any claim ; and considering that the seed is then submitted to a journey of practically a month from Calcutta to Priok it may be taken that it loses another 10 to 20% in value, so that 50% at Priok might be considered as a small percentage and justifying a complaint, but not entitling to any compensation. These figures of 50 and 70% must be further considered by the Committee, but they serve as a basis for discussion as to the sharing of the risk.

Secondly the planters must demand, that their wishes as regards *packing* must be strictly followed.

Our conclusions about above said question are the following.

The *chests should be big enough*, all of the *same sizes*, made of *thick strong boards and strengthened* by iron hoops (according to fig. 4). The chest-sides should be strengthened in some way by means of triangular pieces of wood. Moreover they should be *covered with strong sacking*. The chests should be *almost completely filled up* and the seeds should be plentifully wrapped by packing material. Therefore they should be advised against small cases. The best measurements (interior) of the chests are the following: 31 cm. (12 inches) in height, 31 cm. (12 inches) in breadth 54 cm. (18 inches) in length. The thickness of the boards must be 18—19 mm. ($\frac{3}{4}$ of an inch.)

The best way to pack up the seeds is "stratified": i.e. *in layers separated by sheets of strong paper* in order to prevent the packing sinking to the bottom of the case and leaving the upper part of the seeds unpacked.

As to the kind of packing material we cannot yet draw any definite conclusion. It seems to be, that the use of charcoal powder has its drawbacks. One better pack the seeds *in dry clay or in a mixture of earth and charcoal.* Sand is not worth recommending.

The packing should be *somewhat moist* (*by no means too moist*). We shall try by experiments to fix the degree of moisture most efficient to the purpose and publish it by means of a circular letter *before* forwarding the first lot.

Some planters would have it that importers should give a guarantee of germination on their Estates, but this is quite impracticable as the importers certainly would not undertake the risk of the journey in Java, nor the delays which frequently occur on the Estates in the examination of the seed owing to scarcity of labour. It is thus obvious that the basis of discussion must be the control at Priok.

The best plan seems to be that suggested to us by one of the importers, which would certainly be accepted by most of them, i.e. that the price of the seed should be reduced on a given scale based on a given percentage, and raised if above that percentage. An example with figures will make it clear how this would work: Suppose we have an invoice at F. 200.—per maund containing say 70—80% satisfactory seed, then it should be paid for at the contract price, from 70—50% the price should be proportionately reduced to say F. 150.—according to a fixed scale, while above 80% the price should be raised to say F. 250.—for an invoice giving 100% satisfactory seed. For the various jats a scale of price reduction would have to be fixed, similar to the "schedule" used in British India and published in our Memoranda XX page 107. The above mentioned figures are merely selected haphazard as an illustration, and it goes without saying, that all such points would have to be carefully gone into by the Committee of planters and importers appointed to consider the measures required.

Another point needing the most careful investigation is the basis to be used in determining the percentage of satisfactory seed. The number of sinkers can be taken, but as we have said, this method which gives only a rough indication, is only satisfactory in

some cases, and cannot be considered conclusive. To take as satisfactory only these seeds classed by us as good would be too severe, and would not agree with the actual value of most shipments, so we think that on the whole, for the reasons given it is best to take as satisfactory the "good" and "doubtful" seeds together.

By an examination of the two sets of figures given above, regarding the results of our 99 tests this year, we find that it is difficult to lay down a hard and fast rule merely on the sinkers tests, and the figures do not shew us exactly how to decide which classification is in the majority, so that any discussion based on this test must always be haphazard. From the second set of figures however, shewing the total of good and doubtful seed, we can see that the majority of the shipments (35) contained 70—80% satisfactory seed. On the supposition that our suggestion was adopted, these shipments would thus be paid for at the contract price ; 26 would be paid for at slightly less, 13 would have their price slightly raised (80—90%), while 21 (below 60%) would have their price considerably reduced and 4 (90—100%) would be considerably raised. Herein, we think, is the basis on which all can easily agree and there remains then only to consider, whether below 50% there ought to be a further reduction in price. It occurs seldom in practice, just as in Calcutta shipments are seldom found below 70%. We found less than 50% in 8 cases out of 99 and 5 of these were of seed sent under special conditions, and thus not to be compared with the other shipments.

If the sinkers test is adopted then another method of settlement must be fixed, and it might perhaps be well to adopt the plan followed on some Estates i.e. to take the sinkers after 12 hours in water.

To free the experts from all liability, and to avoid the chance of unfavourable criticism either by planters or importers, it ought not to be difficult to find some one at Buitenzorg who could act as Agent of both parties, and attend at all the tests.

APPENDIX.—Ordinance regarding the import of Tea-seed.

Article 1.

(1) It is prohibited to import tea seed into Netherlands India unless this seed is first examined by an expert appointed by the Director of Agriculture, Industry and Commerce—who can issue documentary permission for the import.

(2) The material or materials serving or having served for packing of the seed, are also submitted to this prohibition.

(3) The examination takes place exclusively in Tandjong Priok.

(4) For special reasons the Director of Agriculture, Industry and Commerce, may allow the import elsewhere without the examination and permission comprised under Section 1 of this article.

Article 2.

(1) The importer is bound to advise the arrival of a consignment of tea seeds immediately by letter to the Director of Agriculture, Industry and Commerce, who, as soon as possible, orders the expert mentioned under Section 1 of Article 1 to make enquiries regarding the condition and quality of the seed.

(2) Pending the inquiry the said expert takes precautionary measures against infection of the tea seed by other tea seed which may be in the neighbourhood of the place where the examination takes place.

Article 3.

(1) The expert may refuse to issue a permit for import unless :—

a. a document, issued in the land of origin, guaranteeing that the seed was in good condition when despatched from there, can be shown.

b. the importer can give sufficient information regarding the garden from which the seed comes.

c. the importer is prepared to hand over a number of seeds, to the limit of one hundred, from each case or other parcel, free of expense or at the quoted price.

d. the seed is, in the expert's opinion, in such condition or of such quality, that if planted, there should be no risk of damage to existing tea estates.

(2) The Director of Agriculture, Industry and Commerce appoints or approves of the author of the document mentioned under *a.* of the 1st paragraph of this article

(3) Seed, for which no permit for import is issued, unless it is sent abroad at importer's expense, at the earliest opportunity must be destroyed in a manner laid down by the expert, without the importer having a claim to any indemnification.

Article 4.

(1) The expert is authorized to order that seed suspected of being infected, is to be disinfected before being imported.

(2) This disinfection takes place in the name of the Government, at importer's expense, the Government not being held responsible for the consequences.

Article 5.

(1) The permission mentioned under 1. of art. 1 must be presented at the Custom-House at Tandjong Priok together with the other papers necessary when goods are being imported.

(2) Above mentioned permission must be shown also on giving notice of the forwarding to any place situated in Netherlands India, unless the Director of Agriculture, Industry and Commerce has decided, on authority of the 4th paragraph of art. 1, that the seeds may be imported without examination.

Article 6.

(1) In case tea seeds are imported contrary to the stipulations of art. 1, a fine to the limit of f. 1000 (one thousand guilders) must be paid.

(2) The destruction of the seeds and packing material may be ordered whether the permit be granted or not.

SOIL DENUDATION BY RAINFALL AND DRAINAGE AND CONSERVATION OF SOIL MOISTURE.

The following paper was written by A. Howard, Esq., Imperial Economic Botanist, and distributed to the members of the meeting of the 8th Board of Agriculture held at Coimbatore in December last.

Soil Denudation by Rainfall and drainage and Conservation of Soil Moisture.

This paper has been prepared, at the request of the President, for the consideration of the Committee of the Board of Agriculture appointed to deal with soil denudation, drainage and water conservation. No effort has been made to treat the subject exhaustively. The note is intended merely as a personal contribution to the discussion of a subject of great interest and of very wide application to Indian Agriculture.

Soil Denudation.

The whole of the cultivated area of India affected by the monsoon is subject to the loss of fine soil by rain wash. These losses are accentuated by the uneven distribution of the rainfall and by the occurrence of heavy falls which often exceed six inches in a single day. The amount of this annual loss varies according to local conditions and is by no means restricted to those areas where the slope of the land is considerable. Even in tracts of the Gangetic plain like North Bihar, where the difference of level between the high and the low lands is only a few feet, the damage done by wash is enormous and the amount is hardly realised. One of the results of this wash in Bihar has been to remove the fine soil-particles from the higher lands and to deposit them in the rice areas. In consequence, the fertility and water holding capacity of the high lands can only be kept up by the application of organic manures, while the thickness of the stratum of soil suitable for rice

in the rice areas is much greater than is necessary for this crop. The extra soil washed down into the rice areas can be regarded as so much unproductive and lost capital.

At Pusa, some attention has been paid to this subject during the last eight years and methods have been devised to check the loss of fine soil by rain which used to take place every monsoon. The large fields have been divided into smaller areas so as to break up the run off into units and so dissipate its destructive energy. Each small field is surrounded by trenches and narrow grass borders which serve both to conduct away the run off and also to hold up the fine soil. A process of natural terracing goes on, the fields level themselves, and the loss of soil is largely prevented. Each field deals with its own rainfall only.

In addition to the loss of soil in the Gangetic plain there are many other well known examples of denudation in India such as that on the black soils of Peninsular India and on the karewa* lands in Kashmir. In the former case, various systems of embankments are practised to some extent, but in Kashmir nothing is done to save the fine soil of the upper terraces of the valley.

The prevention of soil denudation by rain wash in India seems to be a matter well worth the attention of the Agricultural Department. I am aware that work is already in progress on this subject in some localities but there can be no question that it is not receiving the attention the subject deserves. Much is being done to find the cheapest manures for crops but less attention is being paid to the loss of fine soil which, if prevented, would render manure not so necessary in the future.

It is in the planting areas of the East however that the best examples of soil denudation are to be seen. In the hill tracts in the centre of Ceylon, an area which is now covered with the gardens, the original forest canopy was removed to make room for coffee which later gave place to tea. Little or no provision was made at the time to retain in situ the fine soil of the original forest

* The karewa lands in Kashmir are upper alluvial terraces on the side of the valley and at a higher level than the plain through which the Jhelum now flows. These lands are much denuded by rain wash and only carry small crops.

and in consequence the loss of soil has been enormous and is still going on. The water retaining power and fertility of the tea soils of the hill regions of Ceylon have fallen off on account of the loss of fine particles and large sums are spent annually in adding green and other manures to the land. The agricultural capital of the Island has been allowed to run to waste and can never be replaced by any system of manuring. This short-sightedness is remarkable considering the local examples of terracing for rice on the sides of the valleys where the preservation of the soil has been carried to a fine art. There is no doubt that the best way in which the planting industry could have been assisted would have been by the enforcement of a regulation to terrace immediately all lands from which the forest canopy had been removed. I have heard that such a regulation is in force in Java. I am not familiar with the local conditions of the planting industries in the Federated Malay States, in Assam, and in Southern India, but I understand that in several of these tracts such as the Malay States, Southern India and the Darjeeling tea tract, this question of rain wash is one of the greatest importance. It is difficult of course to remedy the mistakes of the past by the measures open to Government, but it seems to be a matter for consideration whether something cannot be done in the future in India where forest land is sold for planting purposes. The difficulty will be to frame rules with regard to terracing which while allowing of the development of the country nevertheless check the destruction of the natural agricultural capital, namely, the fine soil, rich in organic matter, made by the forest. The aim should be to allow the development of the country to go on but to prevent the dissipation of its natural resources. The example of Ceylon is sufficient to indicate the damage which results in these matters from the absence of a strong guiding hand.

Drainage.

In a country like India where most of the rainfall is frequently compressed into a period of about four months, the subject of drainage is apt to be disregarded. Where so much is heard about irrigation it is difficult to realise that some tracts of the country, for example Bihar, suffer from too much rain and are in need not

of elaborate systems for the distribution of canal water but rather of some provision for getting rid of the excess precipitation. Drainage is also of importance in canal irrigated tracts not only in North West India but also in such river deltas as the Godavery where weirs have been built across the rivers so as to convert an ancient system of inundation into one of perennial irrigation.

In Bihar, drainage and soil denudation are intimately connected. The high lands are impoverished by wash and the fields below are waterlogged by the extra water which drains over them from above. The system adopted at Pusa* of making each field deal with its own rainfall not only checks the loss of fine soil but also serves as an efficient method of drainage. The run off is collected from the field trenches into larger channels which lead to the lowlying rice fields where such water is frequently welcome. If the year is one of flood, the extra water brought by these trenches makes no appreciable difference as in any case the crops on the flooded areas will be lost. Further it appears that under this system of drainage the total run off is less than if there were no drains. By splitting up the rainfall, more of it seems to be absorbed by the upper lands than when run off is unchecked. A similar system of drainage to that devised at Pusa can be seen applied on a large scale in Italy particularly in Lombardy. Great care is taken in Italy, to keep the system of surface drains in order and also to cut off from lowlying areas the run off from higher lands which otherwise would convert these low areas into swampy ground.

The advantages of a drainage system in the alluvium are very great. More water is absorbed by the soil, wash is largely checked and the lower fields increase in fertility to a remarkable extent. If the lowlying areas in North Bihar, which now only grow poor crops of rice, could be drained they would be among the finest wheat lands in the world. Not only are the lower fields

* In order to carry out this system of drainage in practice a drainage map is essential. This can best be obtained by following the method originally devised by Sir Edward Buck in 1870 when Settlement Officer in the Farrukhabad District. This consists in marking on an ordinary map the directions in which rain water runs off the land. This enables the various drainage lines to be determined far more easily and cheaply than by any system of taking levels.

rendered more fertile by drainage but their cultivation can be carried out at a less cost and much more rapidly than before. The continuous wheat plot at Pusa, furnishes a good example of the benefits which arise from drainage. Previously this field was often waterlogged and only gave good crops in years of poor rainfall. After being drained, the yield increased and after five crops of wheat without manure there is no sign of any soil exhaustion. The only soil exhaustion I have experienced in Bihar is that due to the loss of available nitrogen by waterlogging which has been shown to produce in a single wheat crop a loss of 16 bushels to the acre (Pusa Bulletin 33, pp. 3, 4).

The indigo estates in Bihar are now paying considerable attention to drainage and already the beneficial results obtained have exceeded expectation. On one estate near Pusa, for example, a beginning was only made during the present year when an area of about 25 acres was divided up into four fields which were also protected from the surface wash of higher land. The results were at once apparent and the owner is convinced that a proper system of drainage is the first condition in any scheme of land improvement in Bihar. If the present rate of progress is maintained, the indigo estates will soon furnish examples of the benefits of drainage in Tirhoot and it may then become a matter for consideration whether or not the improvement of the whole of the Division should not be taken in hand by Government and proper studies made of the rivers and other drainage lines. This has been done in Italy with marked success not only from the point of view of crop production but also from that of the prevention of malaria.*

The necessity of drainage in connection with schemes of canal irrigation in India is well known but it would appear that insufficient attention is still paid to this matter. This is natural considering the time and money entailed in vast irrigation schemes and the desire of the promoters to finish the work quickly and to reduce the cost so that the project may yield high dividends. It is probable that as time goes on the Agricultural Department will

* Sir Edward Buck, Report on the control and utilization of rivers and drainage for the fertilization of land and mitigation of malaria, 1907.

be consulted in all future irrigation projects and will be able to ensure the provision of adequate drainage arrangements.

CONSERVATION OF MOISTURE.

Experience at Pusa and at Quetta confirms the enormous importance of a proper system of conservation of soil moisture. Similar results have also been obtained in the barani* tracts of the Punjab and elsewhere. In the alluvium, the greatest source of loss of soil moisture, while the land is under a rabi crop, is undoubtedly the hard surface crust which forms after rain or after the application of irrigation water. A dry surface is a necessity if the maximum crop is to be produced under barani conditions. Applying one irrigation to the wheat crop at Pusa does more harm than good if the surface skin formed by the water is not broken up thoroughly afterwards.

The most efficient instrument so far found for breaking up surface crusts in the alluvium and in producing a fine dry mulch for a rabi crop is the lever harrow. This implement is an ordinary harrow provided with a lever by which the slope of the tines can be altered at will. By sloping the tines backwards the harrow passes over a young wheat crop without injury and at the same time breaks up any surface crusts leaving a fine dry mulch behind. It has also proved of great use in the cultivation of Java indigo in Bihar during the hot season. At Quetta, its use has increased the yield of dry crop wheat from five to nineteen maunds to the acre. In Bihar these harrows have been taken up by the wheat growers and on estates where they are in use are regarded as indispensable.

Both Pusa and Quetta are good examples of tracts where dry farming is likely to be successful. At both these places the water level is less than 30 feet from the surface and in both cases the soil is alluvial in character. With a proper system of management of the surface soil and the provision of a dry mulch use can be made in crop production of the moisture which rises into the subsoil

* The barani tracts of the Punjab are those in which crops are raised on the natural rainfall without any irrigation.

from below. It is in such tracts, that dry farming methods are most likely to succeed and where the attempt can be made to grow large crops with little or no rainfall. It has been suggested that such methods might be applied in over-irrigated tracts like Amritsar where the subsoil water is only a few feet below the surface and where with a proper system of cultivation good crops might be grown from the ground water supplemented by the rainfall without any irrigation at all.

A NOTE ON THE RELATION BETWEEN THE TEA MOSQUITO (HELOPELTIS THEIVORA) AND THE SOIL

BY

E. A. ANDREWS, B. A.

The question of the distribution of mosquito blight is one of considerable complexity. *Helopeltis theivora*, the tea mosquito, is more or less universally distributed throughout the tea districts of North East India, and yet it is only in certain districts that it does any considerable damage. Why should this be the case? And what are the controlling factors? These are two of the many questions to which this Department is endeavouring to find an answer, and it is intended here to give a short notice of certain results which have been obtained during the prosecution of these endeavours. The investigations are as yet by no means concluded, in fact they may be said to be only just begun, for the material available is but scanty. As, however, the results so far obtained are of considerable importance, they are given here, in the hope that they may prove to be of interest to all concerned.

A study of the distribution of mosquito blight in the Duars)rings out the following points :—

The pest is worst in the extreme west, and, towards the east s, broadly speaking, worst in the gardens furthest from the hills. This is the area occupied by the grey sandy loam of the Duars, :he remaining area being almost wholly Red Bank. Mosquito is evere, however, on certain Red Bank gardens. This might be onsidered to be due to one of two causes :—

1.—The Red Bank, being a richer soil than the grey sandy oam, the tea grown on it is naturally less liable to blight, and

in the Red Bank gardens which get blight, the soil is somewhat deteriorated.

2.—There is some peculiarity in the grey sandy loam which is gradually being acquired by the soil of some of the Red Bank gardens.

At first sight the former appears to be the more plausible suggestion, but in the worst blighted part of Cachar, the Hailakandy district:—

1.—The tea on the teelas, is on the whole, less liable to blight than on the flats.

2.—The tea on the stiff clay flats of the district is less liable to blight than on the bheel.

Here the tea growing on the richest soil is more liable to blight, and, also, the soil on which the tea is least affected, namely the teela soil, is distinctly similar, in chemical composition, to the Red Bank of the Duars. This seems to point to some peculiarity, which, if it be present in the grey sandy loam of the Duars, should be equally present in the bheel, and this is found to be the case.

Five samples from different parts of the grey sandy loam gave on analysis the following percentages of available potash and phosphoric acid :

	I	II	III	IV	V
Potash	·006	·018	·010	·019	·020
Phosphoric acid ...	·049	·095	·024	·037	·034

The ratio of potash to phosphoric acid for these soils :—

	I	II	III	IV	V
$\frac{\text{Potash}}{\text{Phosphoric acid}}$	·122	·189	·416	·513	·559

Five samples from different parts of the Red Bank gave on analysis the following available quantities of the same constituents :—

	I	II	III	IV	V
Potash	·029	·019	·037	·012	·013
Phosphoric acid ...	·009	·009	·017	·008	·012

giving as the ratio of potash to phosphoric acid—

	I	II	III	IV	V
$\frac{\text{Potash}}{\text{Phosphoric acid}}$	5·222	2·111	2·176	1·500	1·083

This ratio is, therefore, low in gardens on the grey sandy loam, and high on unblighted gardens on the Red Bank. Only one set of figures is available for a Red Bank garden which suffers from blight, but here the numbers are as follows :—

potash ... ... ·013
phosphoric acid ... ... ·018

the ratio being $\frac{\text{potash}}{\text{phosphoric acid}}$ ... ·722

showing an approximation to that found in the grey sandy loam.

These facts are very suggestive, the more so as the figures for the teela and bheel soils give the same ratios. Thus, the analysis of five bheel soils show the following available quantities of potash and phosphoric acid :—

	I	II	III	IV	V
Potash	·009	·007	·009	·006	·009
Phosphoric acid ...	·031	·029	·032	·043	·031

giving as the ratio of potash to phosphoric acid :—

	I	II	III	IV	V
Potash / Phosphoric acid	·287	·241	·281	·139	·290

while those of five teela soils show the following available quantities of the same two constituents—

	I	II	III	IV	V
Potash	·006	·022	·020	·013	·011
Phosphoric acid ...	·006	008	·007	·013	·008

giving as the ratio—

	I	II	III	IV	V
Potash / Phosphoric acid	1·000	2·760	2·857	1·000	1·357

Similar figures for the stiff clay flats cannot, unfortunately, be at present obtained.

Analysis taken in the unblighted districts of Assam, where mosquito is present but does no appreciable damage, show high numbers for the same ratio.

Thus it appears that one of the factors controlling the intensity of the attack of the tea mosquito is the ratio of available potash to available phosphoric acid. When this is high the pest is less likely to do damage than when it is low. In the present short note it is unnecessary to give the full analysis from which the ratios have been taken, but the following conclusions may be put forward now. So far as has been at present observed, one may say that mosquito blight is found on tea planted in a variety of

soils in which the actual and relative amounts of the different constituents may be very different, but that the tea planted in soil in which the ratio of available potash to available phosphoric acid is low will be more likely to be attacked by mosquito blight than tea planted in soil in which this ratio is high.

The above observations suggest that there may be the possibility of influencing the susceptibility of bushes to attacks of mosquito blight by manuring in such a way as to alter this ratio in the direction indicated above, that is to say, by applying potash manures to soils in which the potash-phosphoric acid ratio is low, so as to bring them into line with those on which mosquito blight is found to be less prevalent.

FUNGI PARASITIC ON THE TEA PLANT IN NORTH EAST INDIA

By

A. C. Tunstall b. sc.

Part II.

Ascomycetes.

In the last number of this journal the most primitive group of fungi the *phycomycetes* was considered and it was noted that the various forms showed a tendency to evolve in two directions. In the present issue the progression will be continued along the line which terminates in the *ascomycetes.* The group is named after a structure known as an *ascus.* This is a sporangium which contains a definite number of spores which are called *ascospores.* Other spores are produced also in various ways but this type of spore production is the special characteristic of the group. As would be expected there are a number of species which are intermediate between the *ascomycetes* and the *phycomycetes.* These are classed as *hemiascomycetes.*

Hemiascomycetes.

There are three families *Saccharomycetes, Exoasceae* and *Gymnoasceae.* Although no species of these families are parasitic on tea a brief consideration of their characteristics will help to render the descriptions of the true ascomycetes parasitic in tea more interesting and intelligible.

Saccharomyceteae.—This is the yeast family. Its members owe their economic importance to their power of converting sugar into alcohols. Yeast is also used in bread making, the "rising" of which is brought about by the carbonic acid gas given off during the process of alcohol formation. The family has been carefully investigated for many years and a large number of species have

been discovered. The yeast plant is very simple consisting usually of a single cell. The plants reproduce commonly by budding. This takes place under favourable circumstance with remarkable rapidity, the daughter cells often reproducing themselves before they separate from the parent cell. Another type of reproduction which may be considered sexual is by the formation of *endospores.* These are only produced under special conditions. In most species these spores are formed without any sexual process. In others however conjugation similar to that found in the zygomycetes precedes the endospore formation. Two adjacent cells each send out buds which meet. At the point of contact the cell walls dissolve and the two cells fuse. The protoplasm later contracts to form two spheres which finally develop spores. The number of spores produced within each sphere varies ; it is usually two. In one species eight spores are always produced. In the true ascomycetes the number of spores produced in each ascus is constantly eight and it is thought that the eight endospores of the above mentioned yeast are true ascospores and the sphere in which they are produced is a true ascus. Here therefore an apparent transition from the phycomycetes to the ascomycetes is seen.

Exoasceae.—All the members of this family are parasites on plants. The disease of peach trees known as the "leaf curl" is probably the most important. It is caused by *Exoascus deformans.* The leaves of the plant curl up and die. The fungus attacks not only the leaves but extends into the shoots where it spends the winter. The spores are produced on the leaves in asci situated just beneath the epidermis. The asci contain four to six spores which produce secondary spores by budding before they are set free from the ascus. The disease caused extensive damage in the United States until co-operative measures for its eradication were adopted. To remove the disease it is necessary to destroy the infected leaves and shoots and the removal of the diseased parts should be immediately followed by an application of Bordeaux mixture in order to prevent reinfection from spores. Other members of this family produce the formations known as " witches brooms " on trees while others produce leaf blisters much resembling those produced by blister blight of tea.

Gymnoasceae.—The third family is of no great importance but is interesting because the asci are clustered together and protected by a loose weft of hyphae. This is a primitive form of a structure which will be frequently met with in the true ascomycetes where it is known as a *perithecium.* Its object is to protect the asci. Its form is used as a basis of classification.

Ascomycetes.

The number of spores within the ascus is constant for a given species. It is usually eight. Besides ascospores other kinds of spores are produced. The order is divided into two suborders the *pyrenomycetes* and the *discomycetes.*

Pyrenomycetes.—The asci are enclosed within a hollow structure known as a peritheeium. There are many families in this order and as a description of the various characteristics of each family is not likely to interest planters only certain species of direct importance will be considered at length. *Rosellinia,* a fungus which is a common cause of root disease will be described as an example of this suborder.

Rosellinia Root Disease.

There are a number of species, some harmless—feeding on dead organic matter, others destructive—parasites on trees and shrubs. The rosellinias prefer shade and dampness and are rarely able to exist for a long time on well drained, well cultivated tea soils. An attack of the disease generally originates from an old stump situated in a damp shady hollow near the jungle. From this centre should conditions be favourable the disease may spread with alarming rapidity.

If the roots of the dead bushes be examined a greyish or black mycelium will be found around the collar. The bark of the root will sometimes be rough. If this bark be peeled off it will be observed that the fungus has penetrated at various points and spread out fanwise over the wood in flat strands varying in width from 1/16—1/4 of an inch. These strands are at first white but later they become a violet black giving a little of their colour to the surrounding wood. The mycelium when examined under the

nicroscope shows a peculiar structure. Below each septum or livision the hyphae form a pear shaped expansion. This expansion s found in all species of *rosellinia* and is the most marked characeristic of the genus. The first spores are produced soon after the eath of the plant, sometimes before. They are asexual conidiopores and are generally to be found on tufts of black mycelium rojecting from the bark just above ground. A little later a second ind of a sexual spore is produced in special bodies resembling erithecia. These are called *pycnidia*. They are hollow black pheres imbedded in the bark of the root. They can easily be disovered by scraping the rough places. The third and last kind of pore is the ascospore. As these are not formed until the bushes ave been dead a long time they are not commonly found on tea. They are produced in perithecia which are usually borne above round on the twigs of the dead bush. The perithecia are small lack knobs about 1/12—1/20 of an inch across. Examination ith a lens will reveal a tiny opening at the apex of each. This is ie mouth through which the spores escape. A thin section across perithecium examined microscopically shows a black outer coat f densely woven hyphae within which, lying side by side, are a eries of long closed tubes each containing eight elongated spores. Vhen ripe the tubes (or asci) break and the spores are set free.

It is not difficult to remove this disease and if the following eatment be carried out as soon as possible, after the attack has een discovered little damage will be done :—

1. Remove and burn at once all dead wood in the vicinity.
2. Clean away jungle and lay bare the collars of all the surrounding tea bushes.
3. Treat the topmost six inches of the soil of the infected area extending to a complete ring of healthy bushes with half a pound of quicklime per square yard.
4. Improve the drainage if necessary.